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Metallic, thin endless belt for fixing e.g. printer - has mould releasing agent on outer surface and resin layer on inner surface

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Abstract (Basic): JP 6222695 A

The belt has a coating layer with mould releasing property, on an outer peripheral surface of a metallic thin endless belt of 10-35 micron thickness, and has a resin layer on an inner peripheral surface. The coating layer is fluorine resin. The coating layer is a nickel-fluorine resin complex plating layer. The resin layer is the heat-proof resin layer contg. the heat conductive filler. The belt is composed of the polyimide composite contg. 10-40 vol.% of heat conductive filler of 1-20 micron particle size. Both ends of the endless belt is composed of polyimide substantially not including the heat conductive filler.

USE/ADVANTAGE - The fixing belt of high heat conductivity and high rigidity, having the sufficient heat-proof property, strength, insulating property and flexibility, can be obtd. The fixing belt can be effectively used in the high speed fixing in the facsimile and printer.

Dwg.1/4

Title Terms: METALLIC; THIN; ENDLESS; BELT; FIX; PRINT; MOULD; RELEASE; AGENT; OUTER; SURFACE; RESIN; LAYER; INNER; SURFACE
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(54)【発明の名称】　定着用ベルト

(57)【要約】

【目的】　熱伝導性が高く、しかも十分な剛性を有し、十分な可撓性、耐熱性、強度、絶縁性等を備えた定着用ベルトを提供すること。

【構成】　厚み１０～３５μmの金属製薄肉エンドレスベルトの外周面に離型性を有するコーティング層を有し、内周面には樹脂層を有することを特徴とする高剛性・高熱伝導性の定着用ベルト。平均粒径１～２０μmの熱伝導性フィラーを１０～４０容量%含有するポリイミド組成物で形成されたエンドレスベルトからなることを特徴とする高剛性・高熱伝導性の定着用ベルト。

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【特許請求の範囲】

【請求項1】　厚み10～35μmの金属製薄肉エンドレスベルトの外周面に離型性を有するコーティング層を有し、内周面には樹脂層を有することを特徴とする高剛性・高熱伝導性の定着用ベルト。

【請求項2】　コーティング層が弗素樹脂層である請求項1記載の定着用ベルト。

【請求項3】　コーティング層がニッケル－弗素樹脂複合メッキ層である請求項1記載の定着用ベルト。

【請求項4】　樹脂層が熱伝導性フィラーを含有する耐熱性樹脂層である請求項1記載の定着用ベルト。

【請求項5】　平均粒径1～20μmの熱伝導性フィラーを10～40容量%含有するポリイミド組成物で形成されたエンドレスベルトからなることを特徴とする高剛性・高熱伝導性の定着用ベルト。

【請求項6】　エンドレスベルトの両端部が熱伝導性フィラーを実質的に含有しないポリイミドにより形成されている請求項5記載の定着用ベルト。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、電子写真複写機、ファクシミリ、プリンター等の装置において、被転写物に転写された画像を加熱により定着する定着部に用いられる定着用ベルトに関する。

【0002】

【従来の技術】電子写真複写機、ファクシミリ、プリンター等において、印刷・複写の最終段階で、記録紙上のトナーを加熱溶融して、記録紙上に定着させる。例えば、電子写真複写機では、①感光体上に像露光を行って静電潜像を形成する工程、②静電潜像にトナーを付着させて可視像（粉体像）とする工程、③記録紙上に粉体像を転写し、感光体から記録紙を分離する工程、④未定着の粉体像を加熱等の方法で記録紙上に定着させる工程の諸工程を経て複写が行われる。

【0003】定着方法としては、熱定着方式が一般的であり、従来、図1に示すような熱ローラ定着法が汎用されている。熱ローラ定着法では、内部に電熱ヒーター（2）を持ち、外周を離型性のよいゴムまたは樹脂で被覆したヒートローラ（1）とゴムローラ（5）からなる一対のローラを圧接させ、そのローラ間をトナー（3）像が形成された記録紙（4）を通過させてトナーを加熱し、トナーを記録紙上に融着させている。熱ローラ定着法は、効率が高く高速化に適しているが、反面、待ち時間が長いという欠点を有している。即ち、装置の運転開始時にヒートローラ（1）を所定の温度まで加熱する時間が必要であるため、電源投入から運転可能となるまでの間に待ち時間が発生する。また、ヒートローラ全体を加熱しなければならないため、消費電力も大きい。

【0004】そこで、近年、図2に示すように、フィルム状のエンドレスベルト（6）を介して、ヒーター

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（7）により、被転写物上のトナーを加熱する定着方法が提案されている。このエンドレスベルト定着法では、定着用ベルト（6）とゴムローラ（10）を圧接させ、この間にトナー（8）像が形成された記録紙（9）を通過させ、ヒーター（7）により加熱し、トナーを記録紙上に融着させる。この定着方法では、薄いフィルム状のベルト（6）を介するだけで、ヒーター（7）により実質的に直接加熱するため、加熱部が短時間で所定の温度に達し、電源投入時の待ち時間がほぼゼロとなる。さらに、必要部分のみ加熱するため、消費電力も少ないという利点がある。エンドレスベルト定着法に用いられる定着用ベルトとしては、従来、要求される耐熱性、ヤング率、強度、ベルト内面の絶縁性等を考慮して、ポリイミド製のエンドレスベルトの表面に弗素樹脂のコーティング層を設けたものが用いられている。

【0005】

【発明が解決しようとする課題】エンドレスベルト定着法に用いられる定着用ベルトとしては、耐熱性、ヤング率、強度、絶縁性などに優れているとともに、熱伝導性に優れていることが要求される。特に、定着速度を高めるためには、高い熱伝導性を有する定着用ベルトが望ましい。ところが、従来のポリイミド製ベルトは、熱伝導率の低い樹脂のみで形成されているため、熱伝導性が不十分であり、高速化に十分適応することができない。また、この定着方法では、定着用ベルト自身に適度な剛性を持たせることにより、ベルトのしわやつぶれのないスムーズな回転を可能としているが、従来のポリイミド製ベルトでは、定着速度を高めた場合、ベルトのしわやつぶれが起こり易い。

【0006】したがって、定着用ベルトには、高速化のために、熱伝導性と剛性とが共に優れていることが求められる。さらに、この定着用ベルトは、ヒーターと接する部分で、変形を繰り返しながら回転するため、十分な可撓性を有することが要求される。また、ヒーターとの絶縁のため、ベルト内周面は絶縁性であることが必要がある。以上のほか、定着用ベルト両端部には、非回転部との接触によるベルトの破れの問題があるため、引裂強度の高いことが要求される。

【0007】しかしながら、従来、上記要求特性を満たす定着用ベルトは、未だ得られていない。例えば、熱伝導性を改善するためには、ポリイミド製ベルトを薄くする方法が考えられるが、この場合、薄肉化により剛性が低下するため、要求特性を満たすことはできない。本発明の目的は、熱伝導性が高く、しかも十分な剛性を有する定着用ベルトを提供することにある。また、本発明の目的は、十分な可撓性、耐熱性、強度、絶縁性等を備えた定着用ベルトを提供することにある。

【0008】本発明者らは、前記従来技術の問題点を解決するために鋭意研究した結果、エンドレスベルトの基体として熱伝導性と剛性に優れた薄肉の金属を用い、そ

の外周面には離型性を有するコーティング層を設け、内周面には樹脂層を形成して絶縁性を付与することにより、前記諸特性を満足する定着用ベルトの得られることを見出した。また、ポリイミドに熱伝導性フィラーを配合した樹脂組成物から形成されたエンドレスベルトが前記諸特性を満足することを見出した。本発明は、これらの知見に基づいて完成するに至ったものである。

【0009】

【課題を解決するための手段】かくして、本発明によれば、厚み10～35μmの金属製薄肉エンドレスベルトの外周面に離型性を有するコーティング層を有し、内周面には樹脂層を有することを特徴とする高剛性・高熱伝導性の定着用ベルトが提供される。また、本発明によれば、平均粒径1～20μmの熱伝導性フィラーを10～40容量%含有するポリイミド組成物で形成されたエンドレスベルトからなることを特徴とする高剛性・高熱伝導性の定着用ベルトが提供される。以下、本発明について詳述する。

【0010】定着用ベルト（1）

本発明の定着用ベルトの一つは、離型性を有するコーティング層、薄肉金属層及び樹脂層からなる3層構造のエンドレスベルトである。ベルトの外周面にコーティング層、内周面に樹脂層が、それぞれ設けられている。

【0011】金属製薄肉エンドレスベルトの厚みは、10～35μmであることが必要である。基体の金属層をこの範囲の厚みとすることにより、高熱伝導性、高剛性で、かつ、十分な可撓性を有する定着用ベルトを得ることができる。金属ベルトの厚みが10μm未満の場合、定着用ベルトの剛性はポリイミド製ベルトと同程度であり、剛性の向上効果が不十分である。一方、金属ベルトの厚みが35μmを越える場合には、定着用ベルトの回転使用時に、ヒーター部での繰り返し変形により、比較的短期間で回転軸方向の亀裂を生じるため、耐久性が低下する。

【0012】金属製薄肉エンドレスベルトは、ステンレス製金型を用いてメッキ法により作成することができる。使用する金属としては、チューブ製法及び剛性の点でニッケルが好ましい。金属ベルト外周面の離型性を有するコーティング層は、離型性及び耐熱性の観点から、弗素樹脂またはニッケル－弗素樹脂複合メッキにより形成されたものであることが好ましい。10～40容量%の弗素樹脂を有するニッケル－弗素樹脂複合メッキを用いると、コーティング層の熱伝導性を弗素樹脂単体の場合より大幅に向上させることが可能であるため、特に好ましい。コーティング層の厚みは、通常3～20μ、好ましくは5～15μm程度である。また、金属ベルトとコーティング層との接着性を向上させるために汎用のプライマー層を適宜設けてもよい。

【0013】金属ベルト内周面の樹脂層を形成する樹脂としては、例えば、ポリイミド、ポリアミドイミド、ポリベンゾイミダゾール、ポリベンゾオキサゾール、ポリフェニレンサルファイド、ポリエーテルエーテルケトン、液晶ポリマー等の耐熱性樹脂が挙げられる。この樹脂層により、定着用ベルトの絶縁性が確保される。樹脂層の熱伝導率は低いため、通常1～10μm、好ましくは2～8μm程度の厚みとすることが望ましい。

【0014】樹脂層には、熱伝導性を向上させるために、熱伝導性フィラーを含有させることができる。熱伝導性フィラーとしては、例えば、ボロンナイトライド、アルミナ、炭化ケイ素、チタン酸カリウム、窒化アルミ、マイカ、シリカ、酸化チタン、タルク、炭酸カルシウム等の無機フィラー、及びこれらの2種以上の混合物を挙げることができる。熱伝導性フィラーの含有量は、通常5～50容量%、好ましくは10～40容量%、より好ましくは20～30容量%である。この範囲であれば、樹脂単体層とほぼ同レベルの柔軟性を確保した上で、熱伝導率を樹脂単体層の2～3倍に向上させることができる。

【0015】本発明の定着用ベルトは、金属材料を基体としているため、従来のポリイミド製エンドレスベルトと比較して、熱伝導性が大幅に向上している。また、金属ベルト層を10～35μmの厚みとし、さらにその内周面に樹脂層を形成することにより、ポリイミド製エンドレスベルトと同等の可撓性、及び絶縁性を備えている。

【0016】定着用ベルト（2）

本発明のもう一方の定着用ベルトは、ポリイミドに熱伝導性フィラーを含有させた組成物から形成されたエンドレスベルトである。熱伝導性フィラーを含有させることにより、ポリイミド単体を用いた場合と比較して、定着用ベルトの熱伝導性及び剛性が顕著に改善される。

【0017】熱伝導性フィラーの含有量は、10～40容量%、好ましくは20～30容量%である。熱伝導性フィラーの含有量をこの範囲内とすることにより、定着用ベルトとしての十分な可撓性を確保した上で、ポリイミドの熱伝導性及び剛性を向上させることができる。この含有量が10容量%未満であると、十分な熱伝導性向上効果が得られず、逆に、40容量%を越えると、可撓性が不十分となり、定着機で使用した場合に、比較的短期間でベルトに割れを生じる。

【0018】ポリイミドは、通常、テトラカルボン酸二無水物とジアミンを有機極性溶媒中で反応させることにより製造されるが、一般にポリイミドのワニスとして市販されているものが使用できる。ポリイミドのワニスを使用して定着用ベルトのようなフィルム状のものを成形する場合には、熱伝導性フィラーを加えると、フィルム表面に凹凸が生じることがある。

【0019】そこで、本発明では、平均粒径が1～20μmの熱伝導性フィラーを用いることにより、凹凸のない表面状態が良好な薄肉ベルトを得る。熱伝導性フィラ

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ーの平均粒径が1μm未満であると、熱伝導性の向上効果が小さく、20μmを越えると、フィルムに凹凸を生じ易い。したがって、熱伝導性フィラーの平均粒径を1～20μmとすることにより、フィルム表面に凹凸がなく、かつ、熱伝導性の高い定着用ベルトを得ることができる。

【0020】熱伝導性フィラーとしては、例えば、ボロンナイトライド、アルミナ、炭化ケイ素、チタン酸カリウム、窒化アルミ、マイカ、シリカ、酸化チタン、タルク、炭酸カルシウム等の無機フィラー、及びこれらの2種以上の混合物を挙げることができる。これらの中でも、ボロンナイトライド、アルミナ、炭化ケイ素、チタン酸カリウムが好ましい。熱伝導性フィラーの形状は、球状、鱗片状、繊維状のいずれでもよいが、剛性向上の観点から、鱗片状及び繊維状が好ましい。

【0021】定着用ベルトの両端部は、非回転部との接触により破れ易いため、特に引裂強度の高いことが要求される。ところが、ポリイミドに熱伝導性フィラーを添加すると、ポリイミド製ベルトの引裂強度が低下する。一方、定着用ベルト両端の数mmの部分は、トナーの定着に寄与しないため、必ずしも高熱伝導性とする必要はない。そこで、ベルト両端の数mmの部分のみ、熱伝導性フィラーを含まないかあるいは含有量の少ないポリイミドで形成することにより、両端部の引裂強度を十分に高く保持することができる。

【0022】

【実施例】以下、本発明について、実施例及び比較例を挙げて具体的に説明するが、本発明は、これらの実施例のみに限定されるものではない。なお、実施例及び比較例における性能評価のための試験方法は、次の通りである。

＜熱伝導率＞熱伝導率は、京都電子工業（株）製の迅速熱伝導率計Ｋｅｍｔｈｅｒｍ　ＱＴＭ－Ｄ３で測定した。

＜圧縮破壊荷重＞圧縮破壊荷重は、ベルトを長さ20mmに切断し、インストロン試験機で上下から圧縮して、破壊荷重を測定した。

＜実機回転強度試験＞ベルトを定着模擬機に取り付け、Ａ４サイズの紙が1分間に8枚通紙する速度（40mm／秒）に設定して、実際に通紙し、通紙した紙の枚数を数え、かつ、ベルトに亀裂等の異状がないかを目視で観察した。

【0023】［実施例1］厚さ20μm、直径25mm、長さ250mmの（株）ディムコ製のニッケルベルトの外側に、ダイキン工業製のプライマー品番ＥＫ－1809ＢＫを、焼結後、1μmになるようにコーティングし、さらに、その外側にダイキン工業製のＰＴＦＥ系弗素樹脂ディスパージョン品番Ｄ－1を、焼結後、10μmになるようにコーティングし、内面には、電気化学工業製のボロンナイトライド品番ＢＮＧＰを30容量％添加した宇部興産製のポリイミドワニスを、硬化後、5μmになるようにコーティングし、それぞれ焼結及び硬化処理を行って、図3に示す層構造の定着用ベルトを作製した。

【0024】［比較例1］厚さ40μm、直径25mm、長さ250mmの（株）ディムコ製のニッケルベルトの外側に、ダイキン工業製のプライマー品番ＥＫ－1809ＢＫを、焼結後、1μmになるようにコーティングし、さらに、その外側にダイキン工業製のＰＴＦＥ系弗素樹脂ディスパージョン品番Ｄ－1を、焼結後、10μmになるようにコーティングし、内面には、電気化学工業製のボロンナイトライド品番ＢＮＧＰを30容量％添加した宇部興産製のポリイミドワニスを、硬化後、5μmになるようにコーティングし、それぞれ焼結及び硬化処理を行って、図4に示す層構造の定着用ベルトを作製した。実施例1及び比較例1で作成した各定着用ベルトの性能評価の結果を表1に示す。

【0025】

【表1】

7　　8

評価項目		実施例1	比較例1
各層の厚み（μm）	ニッケル層	20	40
	プライマー層	1	1
	フッ素樹脂	10	10
	内面の樹脂層	5	5
熱伝導率（Kcal／m・h・℃）		0.52	0.50
圧縮破壊荷重（Kg）		8	15
実機回転強度試験（枚）		10万枚使用しても、異常はない。	1万枚使用した時点で亀裂が発生した。

各定着用ベルトの性能評価の結果、実施例１の定着用ベルトは、１０万枚以上通紙しても何の異常も見られなかったのに対し、比較例１の定着用ベルトでは、１万枚の通紙でヒーター方向に亀裂が生じ、使用できなくなった。

【００２６】［実施例２］宇部興産製ポリイミドワニスに、平均粒径１．５μmの昭和電工製ボロンナイトライドを加え、攪拌機で３０分攪拌後、真空脱泡を行い、熱伝導性フィラー入りワニスを得た。フィラーの添加量は、ワニス硬化後に２０容量％となるよう調整した。このワニスを円柱金型上にディッピングにより、一定厚に付着させた。次いで、１５０℃～４５０℃の段階的加熱により、溶媒の除去とともにイミド化を行い、最後に金型を引き抜くことにより、シームレスのエンドレスベルトを得た。

【００２７】熱伝導性評価のため、このベルトの内面を２００℃に保持したヒーター上に密着させ、ベルト外面が２００℃に達するのに要する時間を測定した。この時間は、ベルト厚みが４００μmの場合、３．１秒であり、熱伝導性に優れたものであった。また、このベルトの弾性率は、９２０ｋｇ／mm²であった。

【００２８】［比較例２］宇部興産製ポリイミドワニスを用いて、実施例１と同様の方法により、ボロンナイトライドを含有しないポリイミド製のエンドレスベルトを得た。実施例１と同様の方法により、熱伝導性を評価したところ、２００℃までの昇温に５．６秒を要した。また、このベルトの弾性率は、８５０ｋｇ／mm²であった。

【００２９】［比較例３］宇部興産製ポリイミドワニスに、平均粒径４０μmの昭和電工製ボロンナイトライドを加え、実施例１と同様の方法により、シームレスのエンドレスベルトを得た。このベルトには、細かな凹凸があり、ヒーターに密着させることができなかった。また、このベルトの弾性率は、６００ｋｇ／mm²にすぎなかった。

【００３０】

【発明の効果】本発明による定着用ベルトは、ファクシミリ、プリンター等に使用される定着用ベルトとして必要な可撓性、絶縁性を確保した上で、従来のポリイミド製ベルトより大幅に高い熱伝導性と剛性を有するものであり、ファクシミリ、プリンター等の定着速度の高速化を可能とする効果がある。

【図面の簡単な説明】

【図１】ヒートロールを用いた従来の定着方法の説明図である。

【図２】エンドレスベルトを用いた定着方法の説明図である。

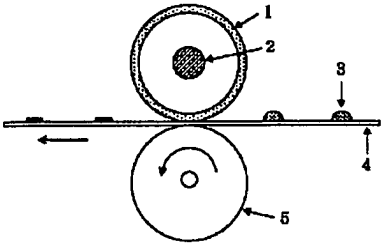
【図３】実施例１で作成した定着用ベルトの層構成図である。

【図４】比較例１で作成した定着用ベルトの層構成図である。

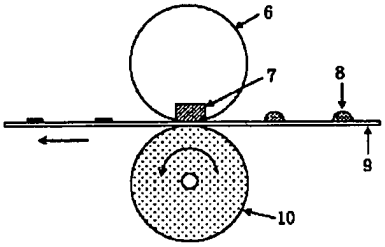
【符号の説明】

１．ヒートローラ
２．ヒーター
３．トナー
４．記録紙
５．ゴムローラ
６．エンドレスベルト
７．ヒーター
８．トナー
９．記録紙
１０．ゴムローラ
１１．弗素樹脂層
１２．プライマー層
１３．ニッケルベルト
１４．ボロンナイトライド含有ポリイミド

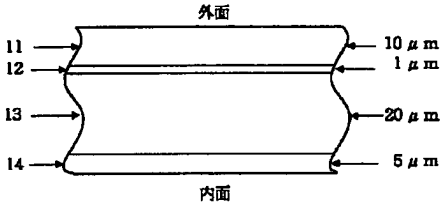
【図1】


1
2
3
4
5

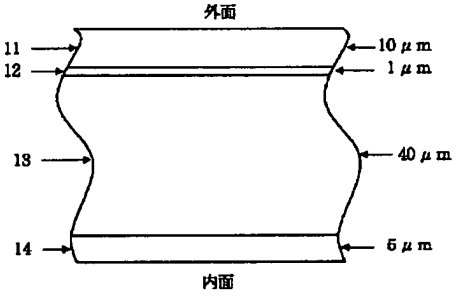
【図2】


6
7
8
9
10

【図3】


外面
11
12
13
14
10 μm
1 μm
20 μm
5 μm
内面

【図4】


外面
11
12
13
14
10 μm
1 μm
40 μm
5 μm
内面

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CLAIMS

[Claim(s)]
[Claim 1] The belt for fixing of high rigidity and high temperature conductivity characterized by having the coating layer which has a mold-release characteristic in the peripheral face of a metal light-gage endless belt with a thickness of 10-35 micrometers, and having a resin layer in inner skin.
[Claim 2] The belt for fixing according to claim 1 whose coating layer is a fluororesin layer.
[Claim 3] The belt for fixing according to claim 1 whose coating layer is a nickel-fluororesin compound deposit.
[Claim 4] The belt for fixing according to claim 1 which is the heat-resistant-resin layer in which a resin layer contains a thermally conductive filler.
[Claim 5] The belt for fixing of high rigidity and high temperature conductivity characterized by consisting of an endless belt formed with the polyimide constituent which does 10-40 capacity % content of a thermally conductive filler with a mean particle diameter of 1-20 micrometers.
[Claim 6] The belt for fixing according to claim 5 currently formed with the polyimide with which the both ends of an endless belt do not contain a thermally conductive filler substantially.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the belt for fixing used for the fixing section established with heating in the image imprinted by the transferred object in equipments, such as an electrophotography copying machine, facsimile, and a printer.
[0002]
[Description of the Prior Art] You carry out heating fusion of the toner in the record paper, and make it established in the record paper in the culmination of printing and a copy in an electrophotography copying machine, facsimile, a printer, etc. For example, in an electrophotography copying machine, a fine-particles image imprints in the process which performs image exposure and forms an electrostatic latent image on ** photo conductor, the process which a toner is made to adhere to ** electrostatic latent image, and is used as a visible image (fine-particles image), and ** record paper, and a copy is performed through the process which separates the recording paper from a photo conductor, and many processes of a process of fixing non-established ** fine-particles image in the record paper by approaches, such as heating.
[0003] As the fixing approach, a heat fixing method is common and the heat roller establishing method as shown in drawing 1 is conventionally used widely. By the heat roller establishing method, it has an electrical heater (2) in the interior, and the pressure welding of the roller of a pair which consists of a heating roller (1) which covered the periphery by the good rubber or the resin of a mold-release characteristic, and a rubber roller (5) is carried out, the recording paper (4) with which the toner (3) image was formed in between the roller is passed, a toner is heated, and welding of the toner is carried out in the record paper. On the other hand, the heat roller establishing method has the fault that the latency time is long, although effectiveness is highly suitable for improvement in the speed. That is, since the time amount which heats a heating roller (1) to predetermined temperature is required at the time of the start up of equipment, by the time operation becomes possible from powering on, the latency time will occur. Moreover, power consumption is also large in order to have to heat the whole heating roller.
[0004] Then, as shown in drawing 2 in recent years, the fixing approach of heating the toner of a transferred lifter at a heater (7) is proposed through the film-like endless belt (6). By this endless-belt establishing method, the pressure welding of the rubber roller (10) is carried out to the belt for fixing (6), the recording paper (9) with which the toner (8) image was formed in the meantime is passed, it heats at a heater (7), and welding of the toner is carried out in the record paper. By this fixing approach, only by minding the belt (6) of the shape of a thin film, in order to heat directly substantially at a heater (7), a heating unit reaches temperature predetermined in a short time, and the latency time of a power up serves as zero mostly. Furthermore, in order to heat only a need part, power consumption also has the advantage of being few. As a belt for fixing used for the endless-belt establishing method, what prepared the coating layer of fluororesin in the front face of the endless belt made from polyimide is conventionally used in consideration of the insulation of the thermal resistance demanded, Young's modulus, reinforcement, and a belt inside etc.
[0005]
[Problem(s) to be Solved by the Invention] As a belt for fixing used for the endless-belt establishing method, while excelling in thermal resistance, Young's modulus, reinforcement, insulation, etc., to excel in thermal conductivity is demanded. In order to raise a fixing rate especially, the belt for fixing which has high thermal conductivity is desirable. However, since the conventional belt made from polyimide is formed only by resin with low thermal conductivity, its thermal conductivity is inadequate and it cannot be adapted for improvement

in the speed enough. Moreover, by the conventional belt made from polyimide, although smooth rotation which does not have wrinkling fellow blurring of a belt by giving moderate rigidity to the belt for fixing itself is enabled by this fixing approach, when a fixing rate is raised, wrinkling fellow blurring of a belt tends to happen.

[0006] Therefore, both the belts for fixing are asked for thermal conductivity and rigidity being excellent for improvement in the speed. Furthermore, this belt for fixing is the part which touches a heater, and in order to rotate repeating deformation, it is required that it should have sufficient flexibility. Moreover, as for belt inner skin, that it is insulation has the need for the insulation with a heater. Since there is a problem [belt / by contact in the nonrotation section] of a tear, it is required for the belt both ends for fixing besides above that tearing strength should be high.
[0007] However, the belt for fixing which fulfills the above-mentioned demand characteristics is not yet obtained conventionally. For example, in order to improve thermal conductivity, how to make the belt made from polyimide thin can be considered, but since rigidity falls by thinning in this case, demand characteristics cannot be fulfilled. The purpose of this invention has thermal conductivity in offering the belt for fixing which has sufficient rigidity high moreover. Moreover, the purpose of this invention is to offer the belt for fixing equipped with sufficient flexibility, thermal resistance, reinforcement, insulation, etc.
[0008] this invention persons found out that the belt for fixing with which are satisfied of said many properties was obtained by preparing the coating layer which has a mold-release characteristic in the peripheral face using the metal of the thin meat which was excellent in thermal conductivity and rigidity as a base of an endless belt, forming a resin layer in inner skin, and giving insulation, as a result of inquiring wholeheartedly, in order to solve the trouble of said conventional technique. Moreover, the endless belt formed from the resin constituent which blended the thermally conductive filler with polyimide found out satisfying said many properties. This invention comes to be completed based on these knowledge.
[0009]
[Means for Solving the Problem] In this way, according to this invention, it has the coating layer which has a mold-release characteristic in the peripheral face of a metal light-gage endless belt with a thickness of 10-35 micrometers, and inner skin is provided with the belt for fixing of high rigidity and high temperature conductivity characterized by having a resin layer. Moreover, according to this invention, the belt for fixing of high rigidity and high temperature conductivity characterized by consisting of an endless belt formed with the polyimide constituent which does 10-40 capacity % content of a thermally conductive filler with a mean particle diameter of 1-20 micrometers is offered. Hereafter, this invention is explained in full detail.
[0010] One of the belts for fixing of belt (1) this invention for fixing is an endless belt of a three-tiered structure which consists of the coating layer, light-gage metal layer, and resin layer which have a mold-release characteristic. A coating layer is prepared in the peripheral face of a belt, and the resin layer is prepared in inner skin, respectively.
[0011] The thickness of a metal light-gage endless belt needs to be 10-35 micrometers. By making the metal layer of a base into the thickness of this range, the belt for fixing which are high temperature conductivity and high rigidity, and has sufficient flexibility can be obtained. When the thickness of a metal belt is less than 10 micrometers, the rigidity of the belt for fixing is comparable as the belt made from polyimide, and is inadequate. [of the rigid improvement effectiveness] On the other hand, at the time of rotation use of the belt for fixing, when the thickness of a metal belt exceeds 35 micrometers, since the crack of the direction of a revolving shaft is produced comparatively for a short period of time, endurance falls according to the repeat deformation in the heater section.
[0012] A metal light-gage endless belt can be created with plating using the metal mold made from stainless steel. As a metal to be used, nickel is desirable a tube process and in respect of rigidity. As for the coating layer which has the mold-release characteristic of a metal belt peripheral face, it is desirable to be formed of fluororesin or nickel-fluororesin compound plating from a mold-release characteristic and a heat-resistant viewpoint. If nickel-fluororesin compound plating which has fluororesin of 10 - 40 capacity % is used, since it is possible to raise the thermal conductivity of a coating layer more sharply than the case of a fluororesin simple substance, it is especially desirable. 3-20micro of thickness of a coating layer is usually about 5-15 micrometers preferably. Moreover, in order to raise the adhesive property of a metal belt and a coating layer, a general-purpose primer layer may be prepared suitably.
[0013] As resin which forms the resin layer of metal belt inner skin, heat resistant resin, such as polyimide,

polyamidoimide, the poly benzimidazole, the poly benzooxazole, polyphenylene sulfide, a polyether ether ketone, and a liquid crystal polymer, is mentioned, for example. The insulation of the belt for fixing is secured by this resin layer. Since the thermal conductivity of a resin layer is low, it is usually desirable to consider as the thickness of about 2-8 micrometers preferably 1-10 micrometers.

[0014] A resin layer can be made to contain a thermally conductive filler in order to raise thermal conductivity. As a thermally conductive filler, inorganic fillers, such as boron nitride, an alumina, silicon carbide, potassium titanate, nitriding aluminum, a mica, a silica, titanium oxide, talc, and a calcium carbonate, and two or more sorts of such mixture can be mentioned, for example. the content of a thermally conductive filler -- usually -- five to 50 capacity % -- desirable -- ten to 40 capacity % -- it is 20 to 30 capacity % more preferably. When it was this range, after securing the flexibility of this level mostly with a resin simple substance layer, thermal conductivity can be raised by 2 to 3 times the resin simple substance layer.

[0015] Since the belt for fixing of this invention is using the metallic material as the base, as compared with the conventional endless belt made from polyimide, its thermal conductivity is improving sharply. Moreover, it has flexibility equivalent to the endless belt made from polyimide, and insulation by making a metal belt layer into the thickness of 10-35 micrometers, and forming a resin layer in the inner skin further.

[0016] Another belt for fixing of belt (2) this invention for fixing is an endless belt formed from the constituent which made polyimide contain a thermally conductive filler. By making a thermally conductive filler contain, the thermal conductivity and rigidity of the belt for fixing are notably improved as compared with the case where a polyimide simple substance is used.

[0017] the content of a thermally conductive filler -- ten to 40 capacity % -- it is 20 to 30 capacity % preferably. After securing sufficient flexibility as a belt for fixing by making the content of a thermally conductive filler into within the limits of this, the thermal conductivity and rigidity of polyimide can be raised. Sufficient heat-conduction disposition top effectiveness is not acquired as this content is under 10 capacity %, but conversely, if 40 capacity % is exceeded, when flexibility becomes inadequate and it is used with a fixing machine, a crack will be comparatively produced to a belt for a short period of time.

[0018] Although polyimide is usually manufactured by making tetracarboxylic dianhydride and diamine react in an organic polar solvent, what is generally marketed as a varnish of polyimide can be used for it. In fabricating the thing of the shape of a film like the belt for fixing using the varnish of polyimide, when it adds a thermally conductive filler, irregularity may arise on a film front face.

[0019] So, in this invention, a surface state without irregularity obtains a good light-gage belt by using the thermally conductive filler whose mean particle diameter is 1-20 micrometers. If the thermally conductive improvement effectiveness is small in the mean particle diameter of a thermally conductive filler being less than 1 micrometer and 20 micrometers is exceeded, it will be easy to produce irregularity on a film. Therefore, by setting mean particle diameter of a thermally conductive filler to 1-20 micrometers, there is no irregularity in a film front face, and the thermally conductive high belt for fixing can be obtained.

[0020] As a thermally conductive filler, inorganic fillers, such as boron nitride, an alumina, silicon carbide, potassium titanate, nitriding aluminum, a mica, a silica, titanium oxide, talc, and a calcium carbonate, and two or more sorts of such mixture can be mentioned, for example. Also in these, boron nitride, an alumina, silicon carbide, and potassium titanate are desirable. Although the shape of a globular shape and a scale and fibrous any are sufficient as the configuration of a thermally conductive filler, the shape of a scale from a viewpoint of rigid improvement and fibrous are desirable.

[0021] In order to tend to tear the both ends of the belt for fixing by contact in the nonrotation section, it is required that especially tearing strength should be high. However, if a thermally conductive filler is added to polyimide, the tearing strength of the belt made from polyimide will fall. On the other hand, since the several mm part of the belt both ends for fixing does not contribute to fixing of a toner, it is not necessary to necessarily make it into high temperature conductivity. Then, the tearing strength of both ends can be held highly enough by forming only the several mm part of belt both ends with polyimide with few contents, excluding a thermally conductive filler.

[0022]

[Example] Although an example and the example of a comparison are given and this invention is explained concretely hereafter, this invention is not limited only to these examples. In addition, the test method for the performance evaluation in an example and the example of a comparison is as follows.

<Thermal conductivity> thermal conductivity is the quick thermal conductivity meter Kemtherm by Kyoto

Electronics Manufacturing Co., Ltd. It measured by QTM-D3.
The <compression breaking load> compression breaking load cut the belt in die length of 20mm, compressed it from the upper and lower sides with the Instron testing machine, and measured the breaking load.
a <system drum strength trial> belt -- a fixing simulation machine -- attaching -- the paper of A4 size -- for 1 minute -- an eight-sheet copy -- it observed visually whether it is set as the rate (40mm/(second)) which carries out paper, and it would actually ****, and the number of sheets of the paper which ****(ed) would be counted, and there would be any troubles, such as a crack, in a belt.
[0023] On the outside of the nickel belt with the [example 1] thickness of 20 micrometers, a diameter [of 25mm], and a die length of 250mm Made from DIMUKO After sintering, Daikin Industries primer lot number EK-1809BK is coated so that it may be set to 1 micrometer. After sintering, the outside is coated with the Daikin Industries PTFE system fluororesin dispersion lot number D-1 so that it may be set to 10 micrometers. Furthermore, inside After hardening, the Ube Industries polyimide varnish which did 30 capacity % addition of the DENKI KAGAKU KOGYO boron nitride lot number BNGP was coated so that it might be set to 5 micrometers, sintering and hardening processing were performed, respectively, and the belt for fixing of the layer structure shown in drawing 3 was produced.
[0024] On the outside of the nickel belt with the [example 1 of comparison] thickness of 40 micrometers, a diameter [of 25mm], and a die length of 250mm Made from DIMUKO After sintering, Daikin Industries primer lot number EK-1809BK is coated so that it may be set to 1 micrometer. After sintering, the outside is coated with the Daikin Industries PTFE system fluororesin dispersion lot number D-1 so that it may be set to 10 micrometers. Furthermore, inside After hardening, the Ube Industries polyimide varnish which did 30 capacity % addition of the DENKI KAGAKU KOGYO boron nitride lot number BNGP was coated so that it might be set to 5 micrometers, sintering and hardening processing were performed, respectively, and the belt for fixing of the layer structure shown in drawing 4 was produced. The result of the performance evaluation of each belt for fixing created in the example 1 and the example 1 of a comparison is shown in Table 1.
[0025]
[Table 1]

評価項目		実施例1	比較例1
各層の厚み（μm）	ニッケル層	20	40
	プライマー層	1	1
	フッ素樹脂	10	10
	内面の樹脂層	5	5
熱伝導率（Kcal／m・h・℃）		0.52	0.50
圧縮破壊荷重（Kg）		8	15
実機回転強度試験（枚）		10万枚使用しても、異常はない。	1万枚使用した時点で亀裂が発生した。

Even if it ****(ed) the belt for fixing of an example 1 100,000 or more sheets, it became impossible for a crack to produce and use it in the direction of a heater by **** of 10,000 sheets by the belt for fixing of the example 1 of a comparison to no abnormalities having been seen as a result of the performance evaluation of each belt for fixing.
[0026] The Showa Denko boron nitride of 1.5 micrometers of mean diameters was added to the polyimide varnish by [example 2] Ube Industries, the agitator performed vacuum degassing after 30-minute stirring, and the varnish containing a thermally conductive filler was obtained. The addition of a filler was adjusted so that it might become 20 capacity % after varnish hardening. This varnish was made to adhere to fixed thickness by dipping on cylinder metal mold. Subsequently, the seamless endless belt was obtained by performing imide-ization with removal of a solvent and finally drawing out metal mold with 150 degrees C - 450 degrees C

gradual heating.
[0027] For thermally conductive evaluation, it was made to stick on the heater which held the inside of this belt at 200 degrees C, and the time amount taken for belt external surface to amount to 200 degrees C was measured. When belt thickness was 400 micrometers, this time amount is 3.1 seconds and was excellent in thermal conductivity. Moreover, 920kg /of elastics modulus of this belt was [mm] 2.
[0028] The endless belt made from polyimide which does not contain boron nitride was obtained by the same approach as an example 1 using the polyimide varnish by [example 2 of comparison] Ube Industries. When the same approach as an example 1 estimated thermal conductivity, by it, the temperature up to 200 degrees C took 5.6 seconds. Moreover, 850kg /of elastics modulus of this belt was [mm] 2.
[0029] The Showa Denko boron nitride of 40 micrometers of mean diameters was added to the polyimide varnish by [example 3 of comparison] Ube Industries, and the seamless endless belt was obtained by the same approach as an example 1. There is fine irregularity in this belt and it was not able to be made to stick to a heater. Moreover, 600kg /of elastics modulus of this belt was [mm] only 2.
[0030]
[Effect of the Invention] The belt for fixing by this invention has conventional thermal conductivity and rigidity sharply higher than the belt made from polyimide, after securing flexibility required as a belt for fixing used for facsimile, a printer, etc., and insulation, and it has the effectiveness which enables improvement in the speed of fixing rates, such as facsimile and a printer.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the belt for fixing used for the fixing section established with heating in the image imprinted by the transferred object in equipments, such as an electrophotography copying machine, facsimile, and a printer.

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PRIOR ART

[Description of the Prior Art] You carry out heating fusion of the toner in the record paper, and make it established in the record paper in the culmination of printing and a copy in an electrophotography copying machine, facsimile, a printer, etc. For example, in an electrophotography copying machine, a fine-particles image imprints in the process which performs image exposure and forms an electrostatic latent image on ** photo conductor, the process which a toner is made to adhere to ** electrostatic latent image, and is used as a visible image (fine-particles image), and ** record paper, and a copy is performed through the process which separates the recording paper from a photo conductor, and many processes of a process of fixing non-established ** fine-particles image in the record paper by approaches, such as heating.
[0003] As the fixing approach, a heat fixing method is common and the heat roller establishing method as shown in drawing 1 is conventionally used widely. By the heat roller establishing method, it has an electrical heater (2) in the interior, and the pressure welding of the roller of a pair which consists of a heating roller (1) which covered the periphery by the good rubber or the resin of a mold-release characteristic, and a rubber roller (5) is carried out, the recording paper (4) with which the toner (3) image was formed in between the roller is passed, a toner is heated, and welding of the toner is carried out in the record paper. On the other hand, the heat roller establishing method has the fault that the latency time is long, although effectiveness is highly suitable for improvement in the speed. That is, since the time amount which heats a heating roller (1) to predetermined temperature is required at the time of the start up of equipment, by the time operation becomes possible from powering on, the latency time will occur. Moreover, power consumption is also large in order to have to heat the whole heating roller.
[0004] Then, as shown in drawing 2 in recent years, the fixing approach of heating the toner of a transferred lifter at a heater (7) is proposed through the film-like endless belt (6). By this endless-belt establishing method, the pressure welding of the rubber roller (10) is carried out to the belt for fixing (6), the recording paper (9) with which the toner (8) image was formed in the meantime is passed, it heats at a heater (7), and welding of the toner is carried out in the record paper. By this fixing approach, only by minding the belt (6) of the shape of a thin film, in order to heat directly substantially at a heater (7), a heating unit reaches temperature predetermined in a short time, and the latency time of a power up serves as zero mostly. Furthermore, in order to heat only a need part, power consumption also has the advantage of being few. As a belt for fixing used for the endless-belt establishing method, what prepared the coating layer of fluororesin in the front face of the endless belt made from polyimide is conventionally used in consideration of the insulation of the thermal resistance demanded, Young's modulus, reinforcement, and a belt inside etc.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] The belt for fixing by this invention has conventional thermal conductivity and rigidity sharply higher than the belt made from polyimide, after securing flexibility required as a belt for fixing used for facsimile, a printer, etc., and insulation, and it has the effectiveness which enables improvement in the speed of fixing rates, such as facsimile and a printer.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As a belt for fixing used for the endless-belt establishing method, while excelling in thermal resistance, Young's modulus, reinforcement, insulation, etc., to excel in thermal conductivity is demanded. In order to raise a fixing rate especially, the belt for fixing which has high thermal conductivity is desirable. However, since the conventional belt made from polyimide is formed only by resin with low thermal conductivity, its thermal conductivity is inadequate and it cannot be adapted for improvement in the speed enough. Moreover, by the conventional belt made from polyimide, although smooth rotation which does not have wrinkling fellow blurring of a belt by giving moderate rigidity to the belt for fixing itself is enabled by this fixing approach, when a fixing rate is raised, wrinkling fellow blurring of a belt tends to happen.

[0006] Therefore, both the belts for fixing are asked for thermal conductivity and rigidity being excellent for improvement in the speed. Furthermore, this belt for fixing is the part which touches a heater, and in order to rotate repeating deformation, it is required that it should have sufficient flexibility. Moreover, as for belt inner skin, that it is insulation has the need for the insulation with a heater. Since there is a problem [belt / by contact in the nonrotation section] of a tear, it is required for the belt both ends for fixing besides above that tearing strength should be high.
[0007] However, the belt for fixing which fulfills the above-mentioned demand characteristics is not yet obtained conventionally. For example, in order to improve thermal conductivity, how to make the belt made from polyimide thin can be considered, but since rigidity falls by thinning in this case, demand characteristics cannot be fulfilled. The purpose of this invention has thermal conductivity in offering the belt for fixing which has sufficient rigidity high moreover. Moreover, the purpose of this invention is to offer the belt for fixing equipped with sufficient flexibility, thermal resistance, reinforcement, insulation, etc.
[0008] this invention persons found out that the belt for fixing with which are satisfied of said many properties was obtained by preparing the coating layer which has a mold-release characteristic in the peripheral face using the metal of the thin meat which was excellent in thermal conductivity and rigidity as a base of an endless belt, forming a resin layer in inner skin, and giving insulation, as a result of inquiring wholeheartedly, in order to solve the trouble of said conventional technique. Moreover, the endless belt formed from the resin constituent which blended the thermally conductive filler with polyimide found out satisfying said many properties. This invention comes to be completed based on these knowledge.

[Translation done.]

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MEANS

[Means for Solving the Problem] In this way, according to this invention, it has the coating layer which has a mold-release characteristic in the peripheral face of a metal light-gage endless belt with a thickness of 10-35 micrometers, and inner skin is provided with the belt for fixing of high rigidity and high temperature conductivity characterized by having a resin layer. Moreover, according to this invention, the belt for fixing of high rigidity and high temperature conductivity characterized by consisting of an endless belt formed with the polyimide constituent which does 10-40 capacity % content of a thermally conductive filler with a mean particle diameter of 1-20 micrometers is offered. Hereafter, this invention is explained in full detail.
[0010] One of the belts for fixing of belt (1) this invention for fixing is an endless belt of a three-tiered structure which consists of the coating layer, light-gage metal layer, and resin layer which have a mold-release characteristic. A coating layer is prepared in the peripheral face of a belt, and the resin layer is prepared in inner skin, respectively.
[0011] The thickness of a metal light-gage endless belt needs to be 10-35 micrometers. By making the metal layer of a base into the thickness of this range, the belt for fixing which are high temperature conductivity and high rigidity, and has sufficient flexibility can be obtained. When the thickness of a metal belt is less than 10 micrometers, the rigidity of the belt for fixing is comparable as the belt made from polyimide, and is inadequate. [of the rigid improvement effectiveness] On the other hand, at the time of rotation use of the belt for fixing, when the thickness of a metal belt exceeds 35 micrometers, since the crack of the direction of a revolving shaft is produced comparatively for a short period of time, endurance falls according to the repeat deformation in the heater section.
[0012] A metal light-gage endless belt can be created with plating using the metal mold made from stainless steel. As a metal to be used, nickel is desirable a tube process and in respect of rigidity. As for the coating layer which has the mold-release characteristic of a metal belt peripheral face, it is desirable to be formed of fluororesin or nickel-fluororesin compound plating from a mold-release characteristic and a heat-resistant viewpoint. If nickel-fluororesin compound plating which has fluororesin of 10 - 40 capacity % is used, since it is possible to raise the thermal conductivity of a coating layer more sharply than the case of a fluororesin simple substance, it is especially desirable. 3-20micro of thickness of a coating layer is usually about 5-15 micrometers preferably. Moreover, in order to raise the adhesive property of a metal belt and a coating layer, a general-purpose primer layer may be prepared suitably.
[0013] As resin which forms the resin layer of metal belt inner skin, heat resistant resin, such as polyimide, polyamidoimide, the poly benzimidazole, the poly benzooxazole, polyphenylene sulfide, a polyether ether ketone, and a liquid crystal polymer, is mentioned, for example. The insulation of the belt for fixing is secured by this resin layer. Since the thermal conductivity of a resin layer is low, it is usually desirable to consider as the thickness of about 2-8 micrometers preferably 1-10 micrometers.
[0014] A resin layer can be made to contain a thermally conductive filler in order to raise thermal conductivity. As a thermally conductive filler, inorganic fillers, such as boron nitride, an alumina, silicon carbide, potassium titanate, nitriding aluminum, a mica, a silica, titanium oxide, talc, and a calcium carbonate, and two or more sorts of such mixture can be mentioned, for example. the content of a thermally conductive filler -- usually -- five to 50 capacity % -- desirable -- ten to 40 capacity % -- it is 20 to 30 capacity % more preferably. When it was this range, after securing the flexibility of this level mostly with a resin simple substance layer, thermal conductivity can be raised by 2 to 3 times the resin simple substance layer.
[0015] Since the belt for fixing of this invention is using the metallic material as the base, as compared with the conventional endless belt made from polyimide, its thermal conductivity is improving sharply. Moreover, it has

flexibility equivalent to the endless belt made from polyimide, and insulation by making a metal belt layer into the thickness of 10-35 micrometers, and forming a resin layer in the inner skin further.
[0016] Another belt for fixing of belt (2) this invention for fixing is an endless belt formed from the constituent which made polyimide contain a thermally conductive filler. By making a thermally conductive filler contain, the thermal conductivity and rigidity of the belt for fixing are notably improved as compared with the case where a polyimide simple substance is used.
[0017] the content of a thermally conductive filler -- ten to 40 capacity % -- it is 20 to 30 capacity % preferably. After securing sufficient flexibility as a belt for fixing by making the content of a thermally conductive filler into within the limits of this, the thermal conductivity and rigidity of polyimide can be raised. Sufficient heat-conduction disposition top effectiveness is not acquired as this content is under 10 capacity %, but conversely, if 40 capacity % is exceeded, when flexibility becomes inadequate and it is used with a fixing machine, a crack will be comparatively produced to a belt for a short period of time.
[0018] Although polyimide is usually manufactured by making tetracarboxylic dianhydride and diamine react in an organic polar solvent, what is generally marketed as a varnish of polyimide can be used for it. In fabricating the thing of the shape of a film like the belt for fixing using the varnish of polyimide, when it adds a thermally conductive filler, irregularity may arise on a film front face.
[0019] So, in this invention, a surface state without irregularity obtains a good light-gage belt by using the thermally conductive filler whose mean particle diameter is 1-20 micrometers. If the thermally conductive improvement effectiveness is small in the mean particle diameter of a thermally conductive filler being less than 1 micrometer and 20 micrometers is exceeded, it will be easy to produce irregularity on a film. Therefore, by setting mean particle diameter of a thermally conductive filler to 1-20 micrometers, there is no irregularity in a film front face, and the thermally conductive high belt for fixing can be obtained.
[0020] As a thermally conductive filler, inorganic fillers, such as boron nitride, an alumina, silicon carbide, potassium titanate, nitriding aluminum, a mica, a silica, titanium oxide, talc, and a calcium carbonate, and two or more sorts of such mixture can be mentioned, for example. Also in these, boron nitride, an alumina, silicon carbide, and potassium titanate are desirable. Although the shape of a globular shape and a scale and fibrous any are sufficient as the configuration of a thermally conductive filler, the shape of a scale from a viewpoint of rigid improvement and fibrous are desirable.
[0021] In order to tend to tear the both ends of the belt for fixing by contact in the nonrotation section, it is required that especially tearing strength should be high. However, if a thermally conductive filler is added to polyimide, the tearing strength of the belt made from polyimide will fall. On the other hand, since the several mm part of the belt both ends for fixing does not contribute to fixing of a toner, it is not necessary to necessarily make it into high temperature conductivity. Then, the tearing strength of both ends can be held highly enough by forming only the several mm part of belt both ends with polyimide with few contents, excluding a thermally conductive filler.

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EXAMPLE

[Example] Although an example and the example of a comparison are given and this invention is explained concretely hereafter, this invention is not limited only to these examples. In addition, the test method for the performance evaluation in an example and the example of a comparison is as follows.
<Thermal conductivity> thermal conductivity is the quick thermal conductivity meter Kemtherm by Kyoto Electronics Manufacturing Co., Ltd. It measured by QTM-D3.
The <compression breaking load> compression breaking load cut the belt in die length of 20mm, compressed it from the upper and lower sides with the Instron testing machine, and measured the breaking load.
a <system drum strength trial> belt -- a fixing simulation machine -- attaching -- the paper of A4 size -- for 1 minute -- an eight-sheet copy -- it observed visually whether it is set as the rate (40mm/(second)) which carries out paper, and it would actually ****, and the number of sheets of the paper which ****(ed) would be counted, and there would be any troubles, such as a crack, in a belt.
[0023] On the outside of the nickel belt with the [example 1] thickness of 20 micrometers, a diameter [of 25mm], and a die length of 250mm Made from DIMUKO After sintering, Daikin Industries primer lot number EK-1809BK is coated so that it may be set to 1 micrometer. After sintering, the outside is coated with the Daikin Industries PTFE system fluororesin dispersion lot number D-1 so that it may be set to 10 micrometers. Furthermore, inside After hardening, the Ube Industries polyimide varnish which did 30 capacity % addition of the DENKI KAGAKU KOGYO boron nitride lot number BNGP was coated so that it might be set to 5 micrometers, sintering and hardening processing were performed, respectively, and the belt for fixing of the layer structure shown in drawing 3 was produced.
[0024] On the outside of the nickel belt with the [example 1 of comparison] thickness of 40 micrometers, a diameter [of 25mm], and a die length of 250mm Made from DIMUKO After sintering, Daikin Industries primer lot number EK-1809BK is coated so that it may be set to 1 micrometer. After sintering, the outside is coated with the Daikin Industries PTFE system fluororesin dispersion lot number D-1 so that it may be set to 10 micrometers. Furthermore, inside After hardening, the Ube Industries polyimide varnish which did 30 capacity % addition of the DENKI KAGAKU KOGYO boron nitride lot number BNGP was coated so that it might be set to 5 micrometers, sintering and hardening processing were performed, respectively, and the belt for fixing of the layer structure shown in drawing 4 was produced. The result of the performance evaluation of each belt for fixing created in the example 1 and the example 1 of a comparison is shown in Table 1.
[0025]
[Table 1]

評価項目		実施例1	比較例1
各層の厚み（μm）	ニッケル層	20	40
	プライマー層	1	1
	フッ素樹脂	10	10
	内面の樹脂層	5	5
熱伝導率（Kcal／m・h・℃）		0.52	0.50
圧縮破壊荷重（Kg）		8	15
実機回転強度試験（枚）		10万枚使用しても、異常はない。	1万枚使用した時点で亀裂が発生した。

Even if it ****(ed) the belt for fixing of an example 1 100,000 or more sheets, it became impossible for a crack to produce and use it in the direction of a heater by **** of 10,000 sheets by the belt for fixing of the example 1 of a comparison to no abnormalities having been seen as a result of the performance evaluation of each belt for fixing.

[0026] The Showa Denko boron nitride of 1.5 micrometers of mean diameters was added to the polyimide varnish by [example 2] Ube Industries, the agitator performed vacuum degassing after 30-minute stirring, and the varnish containing a thermally conductive filler was obtained. The addition of a filler was adjusted so that it might become 20 capacity % after varnish hardening. This varnish was made to adhere to fixed thickness by dipping on cylinder metal mold. Subsequently, the seamless endless belt was obtained by performing imide-ization with removal of a solvent and finally drawing out metal mold with 150 degrees C - 450 degrees C gradual heating.

[0027] For thermally conductive evaluation, it was made to stick on the heater which held the inside of this belt at 200 degrees C, and the time amount taken for belt external surface to amount to 200 degrees C was measured. When belt thickness was 400 micrometers, this time amount is 3.1 seconds and was excellent in thermal conductivity. Moreover, 920kg /of elastics modulus of this belt was [mm] 2.

[0028] The endless belt made from polyimide which does not contain boron nitride was obtained by the same approach as an example 1 using the polyimide varnish by [example 2 of comparison] Ube Industries. When the same approach as an example 1 estimated thermal conductivity, by it, the temperature up to 200 degrees C took 5.6 seconds. Moreover, 850kg /of elastics modulus of this belt was [mm] 2.

[0029] The Showa Denko boron nitride of 40 micrometers of mean diameters was added to the polyimide varnish by [example 3 of comparison] Ube Industries, and the seamless endless belt was obtained by the same approach as an example 1. There is fine irregularity in this belt and it was not able to be made to stick to a heater. Moreover, 600kg /of elastics modulus of this belt was [mm] only 2.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view of the conventional fixing approach using a heat roll.
[Drawing 2] It is the explanatory view of the fixing approach using an endless belt.
[Drawing 3] It is the lamination Fig. of the belt for fixing created in the example 1.
[Drawing 4] It is the lamination Fig. of the belt for fixing created in the example 1 of a comparison.
[Description of Notations]
1. Heating roller
2. Heater
3. Toner
4. Recording Paper
5. Rubber Roller
6. Endless Belt
7. Heater
8. Toner
9. Recording Paper
10. Rubber Roller
11. Fluororesin Layer
12. Primer Layer
13. Nickel Belt
14. Boron Nitride Content Polyimide

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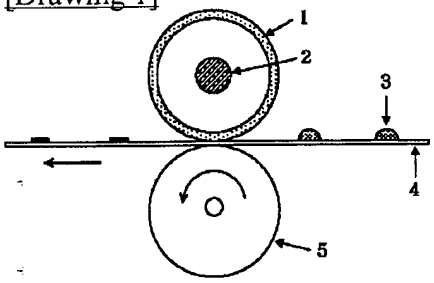
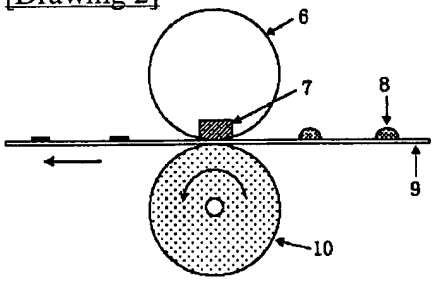
DRAWINGS

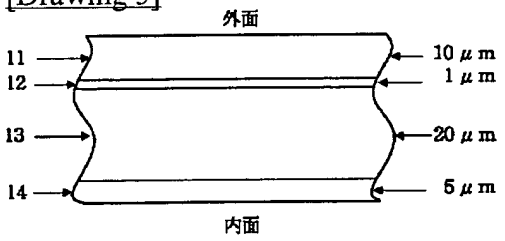
[Drawing 1]



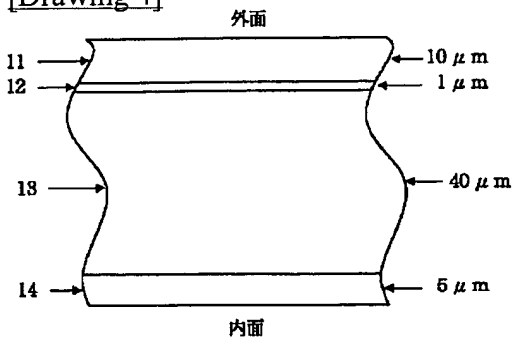
[Drawing 2]



[Drawing 3]



[Drawing 4]



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